

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

Diversion

(Feet)

Code 362

DEFINITION

A channel constructed across the slope with a supporting ridge on the lower side.

PURPOSES

To divert excess water from one area for use or safe disposal in other areas.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to sites where:

1. Runoff damages cropland, pastureland, farmsteads, feedlots, or conservation practices such as terraces or stripcropping.
2. Surface flow and shallow subsurface flow caused by seepage are damaging sloping upland.
3. Runoff is in excess and available for use on nearby sites.
4. A diversion is required as a part of a pollution abatement system.
5. A diversion is required to control erosion and runoff on urban or developing areas and construction or mining sites.

CRITERIA

Capacity. Diversions that protect agricultural land and are part of a pollution abatement system must have the capacity to carry peak runoff from

a 10-year frequency, 24-hour duration storm as a minimum, obtained by using the procedure in Chapter 2, Engineering Field Manual.

Diversions designed to protect areas such as urban areas, buildings and roads shall have enough capacity to carry peak runoff expected from a storm frequency consistent with the hazard involved but not less than a 25-year frequency, 24-hour duration storm with a freeboard not less than 0.3 ft.

Diversions as temporary measures, with a life span of less than 2 years, shall carry as a minimum the 2-year, 24-hour duration storm.

Cross section. The channel may be parabolic, V-shaped, or trapezoidal. The diversion shall be designed to have stable side slopes. The side slopes shall be no steeper than 2:1. The ridge height shall include a minimum of 10 percent for settlement. The ridge shall have a minimum top width of 4 feet at the design elevation. The minimum cross section shall meet the specified dimensions. The top of the constructed ridge shall no be lower at any point than the design elevation plus the specified overfill for settlement.

Grade and velocity. Channel grades may be uniform or variable. Channel velocity shall not exceed that considered non-erosive for the soil and planned vegetation or lining. Channel velocity shall not exceed those given in Table 9-1, Chapter 9, NRCS Engineering Field Manual, for the type of soil and vegetal retardance. The allowable velocity for a bare diversion channel

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shall be determined using a Manning's "n" value of 0.025.

Location. The location of the diversion shall be determined by outlet conditions, topography, land use, cultural operations, and soil type. A diversion in a cultivated field must be aligned to permit use of modern farming equipment.

Diversion used to intercept subsurface flow or seepage should be located based on information from exploration borings to determine the location of the water bearing strata. Location, spacing, and depth will be based on the location of the seepage outcrop(s). Where prolonged seepage will prevent establishment of vegetation, a subsurface drain will be installed parallel to the diversion.

Where a subsurface drain is used along with the diversion in order to establish and maintain satisfactory vegetative cover, the design, materials, and installation procedures will conform to Subsurface Drain (606). The grade of the subsurface drain shall be at least 1 foot below the grade of the diversion channel and offset from the diversion channel centerline at least 1/4 the design top width.

Protection against sedimentation. Diversions should not be used below high-sediment-producing areas unless land treatment practices or structural measures designed to prevent damaging accumulations of sediment in the channels are installed with or before the diversions. If movement of sediment into the channel is a significant problem, a vegetated filter strip shall be used where soil or climate does not preclude its use, and the design shall include extra capacity for sediment and be supported by supplemental structures, cultural or tillage practices, or special maintenance measures.

Outlets. Each diversion must have a safe and stable outlet with adequate capacity. The outlet may be a grassed waterway, a vegetated or paved area, a grade stabilization structure, an underground outlet, a stable watercourse, or a combination of these practices. The outlet must convey runoff to a point where outflow will not cause damage. Vegetation outlets shall be installed before diversion construction to insure

establishment of vegetative cover in the outlet channel.

Underground outlets consist of an inlet and underground conduit. The release rate when combined with storage is to be such that the design storm will not overtop the diversion ridge. On large watersheds, runoff flows are usually too large to outlet entirely through underground outlets. Design according to Underground Outlet (620).

The design elevation of the water surface in the diversion shall not be lower than the design elevation of the water surface in the outlet at their junction when both are operating at design flow.

Temporary diversions. Temporary diversions may be used where their life expectancy is less than two years. They may be used above newly constructed slopes and across graded right-of-way to intercept and divert storm runoff. Temporary diversions must be planned and installed to be stable through their useful life and shall meet the following criteria:

1. Drainage areas do not exceed three acres.
2. The minimum cross section will be as follows:

Top Width	Height	Side Slopes
0	1 ft. Min.	4:1 or flatter
4	1 ft. Min.	2:1 or flatter

Vegetation. Disturbed areas that are not to be cultivated shall be established to grass as soon as practicable after construction. Normally, the channel and ridge, including front and back slopes, shall be seeded and maintained in good vegetation. If soils or climate conditions preclude the use of vegetation for erosion protection, nonvegetative linings such as gravel, rock riprap, or cellular block may be used. Seedbed preparation, seeding, fertilizing and mulching shall comply with recommendations in construction specifications for vegetative establishment. The vegetation shall be maintained and tree and brush controlled by hand, machine, or chemicals.

Surface Mining Control And Reclamation Act of 1977.

"Diversions designed to meet the above act shall also be designed to meet the following:

1. Temporary diversions are those used during mining and reclamation. When no longer needed, temporary diversion structures shall be constructed to safely pass the peak runoff from a precipitation event with a 3-year recurrence interval.
2. Permanent diversion structures shall be constructed to safely pass the peak runoff from a precipitation event with a 10 year recurrence interval with gently sloping banks that are stabilized with vegetation. Asphalt, concrete, or similar linings will not be used unless specifically required to prevent seepage or to provide stability and they are approved.
3. The design freeboard shall be no less than calculated using the following equation:

$$f = 1 + (0.025 \times v \times d)$$

Where f = freeboard in feet; v = design velocity in feet per second; and d = depth of flow in feet."

CONSIDERATIONS

Effects on water quantity and quality shall be considered. A diversion may increase the opportunity for surface water to infiltrate into the soil. This will be on a small percentage of the watershed. A diversion diverts surface water away from the area downslope, reducing the opportunity for the water to infiltrate into the soil in this area. The net effect may be the decrease the amount of water infiltrating into the soil. Diversions may change the location in which surface water may flow, but they may have little effect on the quantity of surface or ground water.

Water Quantity

1. Effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation and ground water recharge.

2. The type of outlet, time of water detention, geology, and topography of the site.

This practice will assist in the stabilization of the watershed, resulting in the reduction of sheet and rill erosion by reducing the length of slope.

Sediment may be reduced by the elimination of ephemeral and large gullies. This may reduce the amount of sediment and related pollutants delivered to the surface waters. This practice diverts surface runoff away from particular areas and prevents the incorporation of any pollutants within these areas into the runoff and transport of these pollutants to the receiving waters.

Water Quality

1. Effects on erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances carried by runoff.
2. Effects of nutrients and pesticides on surface and ground water quality.
3. Filtering effects of vegetation on movement of sediment and dissolved and sediment-attached substances.
4. Short-term and construction-related effects on the quality of downstream water.
5. Effects on the movement of dissolved substances below the root zone and toward the ground water.
6. Potential for uncovering or redistributing toxic materials and low productive soils that might cause undesirable effects on the water or plants.

Special attention shall be given to maintaining and improving visual resources and habitat for wildlife where applicable. The landowner/user will be advised if wetlands will be affected and USDA-NRCS wetland policy will apply. All work planned shall be in compliance with General Manual Title 450-GM, Part 405, Subpart A, Compliance With Federal, State, and Local Laws and Regulations.

PLANS AND SPECIFICATIONS

Plans and specifications for installing diversions shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

Construction specifications

General. Construction operations shall be carried out in such a manner and sequence that erosion and air and water pollution will be minimized and held within acceptable limits. Construction methods that enhance wildlife will be used where practical. Trees, stumps, and brush removed from the construction area may be piled for wildlife habitat when approved by the landowner/user.

The completed job shall present a workmanlike appearance and conform to the line, grades, and elevations shown on the drawings or as staked in the field.

All operations shall be carried out in a safe, skillful manner. Safety and health regulations shall be observed and appropriate safety measures used.

Site preparation. All ditches or gullies shall be filled and trees and other obstructions shall be removed before construction of the fill begins. The base for the diversion shall be scarified so that a good bond is obtained. Unsuitable materials shall be stripped and will be disposed of at approved locations.

Excavation. To the extent needed, all suitable materials removed from the specified excavation shall be used in the construction of the earth fill areas of the diversion. All surplus or unsuitable materials shall be disposed of in a manner that will not interfere with flow into the diversion.

Fill placement. The material placed in fill areas of the diversion shall be free of detrimental amounts of sod, roots, frozen soil, stones over 3 inches in diameter and other objectionable material. The extent they are suitable, excavated materials are to be used as fill. The distribution and gradation of materials shall be such that there will be no lenses, pockets, streaks, or layers of material differing substantially in texture or

gradation from the surrounding material. The work area shall be kept free of standing water when fill is being placed. The placing and spreading of the fill shall be started at the lowest point of the foundation and the fill shall be brought up in approximately horizontal layers not to exceed 9 inches in thickness. Each layer will be compacted by complete coverage with the hauling and spreading equipment.

Where underground conduits are located under a diversion ridge, mechanical compaction or water packing shall be used. Installation and backfill of conduit trenches should be made in advance of other fill placement to allow adequate settlement.

Diversion ridges constructed across gullies or depressions shall be compacted sufficiently to maintain the planned section after settlement.

Moisture control. The minimum moisture content of the fill material and foundation shall be such that when kneaded in the hand the fill material will form a ball that does not readily separate. The maximum moisture content is when conditions are too wet for efficient use of the hauling and compaction equipment.

Construction tolerances. The following are guidelines for diversion construction:

Ridge grade plus settlement to 0.5 ft. above.
Channel grade to 0.2 ft. below.
Top width and bottom width 10% wider not to exceed 5 ft. and 2 ft. respectively.

There will be no reverse grade. Sideslopes will be nominally to grade with no unsightly humps or hollows.

Topsoiling. Topsoil shall be removed and stockpiled and placed on the diversion. Where establishment of vegetation is a problem on exposed subsoils (all subsoils except loam, silt loam and sandy loam except where dense till is present), topsoil shall be respread to provide a seedbed. Areas to be topsoiled in the channel section will be over-excavated to allow for topsoiling to planned grade.

Where subsoil is exposed, or is used in constructing the ridge, topsoil will be placed in accordance with the following criteria:

1. A minimum of four inches of topsoil ("A" horizon) will be placed where six or more inches of friable soil material with good moisture holding properties (more than 0.15 inches per inch) lies below the surface of the cut area in the channel or the ridge.
2. A minimum of eight inches of topsoil ("A" horizon) will be placed where less than six inches of friable soil materials with good moisture holding properties (more than 0.15 inches per inch) lies below the surface of the cut area in the channel or the ridge.
3. Topsoil will be placed in final shaping operations. The underlying soil, if needed, will be chiseled or scarified to permit proper bonding of topsoil.
4. The diversion should be firmly packed prior to seeding.

Finish and cleanup. The diversion and the designated spoil areas will be finished in a relatively smooth condition ready for seeding. All rocks 3" in diameter or larger and roots shall be removed from the diversion and spoil areas.

Vegetative establishment. Whenever possible, excess water shall be directed away from the diversion until vegetation is established. Any protective works shall be removed and the disturbed areas seeded to permanent grass after the vegetation in the diversion channel is established.

If needed, apply lime to raise the pH to the level desired for species of vegetation being seeded.

Fertilize according to soil tests or at a minimum rate of 1000 lbs. of 12-12-12 fertilizer (or its equivalent) per acre as soon as the diversion has been constructed within the seeding periods. Application of 150 lbs. per acre of ammonium nitrate 6-8 weeks after seeding on soils low in organic matter and fertility on high velocity diversion with large drainage areas will greatly improve vegetation establishment. Work the fertilizer and lime into the soil to a depth of 2-3

inches with a harrow or disk. Prepare a firm seedbed with a cultipacker or cultipacker type seeder.

Seed on the following grass mixtures during the preferred seeding periods of March 1 to May 10 or August 10 to September 30.

Species	Minimum Rates of Pure Live Seed
1. Tall Fescue	35# per acre
2. Tall Fescue* Creeping Red Fescue	25# per acre (Shaded sites)
3. Reed canary grass*	18# per acre
4. Ky. Bluegrass*	40# per acre (Urban areas)
5. Smooth Bromegrass	35# per acre

1/4 # per acre of Ladino clover may be added to all but the Ky. Bluegrass seed mixtures.

*Adapted to poorly drained soils.

When construction is completed between May 11 and August 9, a temporary cover crop should be established using one of the following.

Species	Minimum Rates
Wheat	150# per acre
Rye	150# per acre
Spring Oats	100# per acre
Annual Rye grass	20# per acre
Corn	150-300# per acre

After August 10, the temporary cover should be removed or incorporated, fertilizer applied, seedbed prepared and permanent seeding done in normal manner.

On critical sites, mulch with 1 1/2 to 2 tons straw per acre. Anchor the mulch with asphalt spray, netting or a mulch anchoring tool. In areas of sharp breaks in channel grade or where excessive velocities would cause channel scour, paper netting, jute netting, rock lining, erosion control blankets or sod should be used.

OPERATION AND MAINTENANCE

A maintenance program shall be established by the landowner/user to maintain diversion capacity, storage, ridge height, outlets, and vegetative cover. Maintenance needs are to be

discussed with the landowner/user responsible for maintaining the practices installed with NRCS assistance. Diversion ridges can be hazardous for farming operations or mowing. Any hazards must be brought to the attention of the landowner/user or other responsible person. Items to consider are:

1. Do not graze diversion during establishment and when soil conditions are wet.
2. Protect diversion from damage by farm equipment and vehicles. Do not use diversions as a roadway and practice care when crossing to prevent tillage marks or wheel tracks.
3. Keep the ridge at design height with periodic maintenance, if the diversion is farmed over.
4. Remove sediment deposits from channel to maintain the design depth, capacity, and storage and to prevent ponding packets in channel bottom.
5. Fertilize to maintain a vigorous vegetative cover, if the diversion is grassed. Caution should be used in fertilization to maintain water quality.
6. Control tree and brush growth by hand, mechanical or chemical means.
7. Mow diversion regularly to maintain a healthy, vigorous sod. Time the first mowing after nesting birds have hatched (about August 15). Remove excess top growth. Do not burn or overgraze.
8. Promptly repair eroded areas in or adjacent to the diversion.
9. Repair all broken tile lines adjacent to or in diversion.
10. If the diversion is a storage type diversion, keep the riser to an underground outlet clear and redistribute sediment buildup so the riser is in the lowest place.
11. Maintain effective erosion control of the contributing watershed to prevent siltation and the resulting loss of capacity.

